Active vibration isolation of electronic components by piezocomposite clamped–clamped beam

Y. Meyer a,*, M. Collet b

a Institut Supérieur de Mécanique de Paris (SUPMECA Paris), LISMA/Structures, 3 rue Fernand Hainaut, 93407 Saint Ouen Cedex, France
b FEMTO ST Institute, Department LMARC, UMR 6174, 25000 Besançon, France

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Abstract

The sensitive electronic components used in military and aerospace applications endure some intense vibrations. These vibrations have some disturbing effects on the stability and on the service life of these devices. So, protecting these elements becomes a major economic and strategic stake. Vibration isolation can be applied to different levels of the on-board systems. Indeed, it is advisable to isolate electronic components either at the rack level or at the board level or at the component level. In this paper, the last solution is chosen because of low moving masses which imply low control energies.

An active suspension system is located between the host board and the sensitive element to be isolated. This designed control system uses a simple Integral Force Feedback strategy. This vibration isolation control is stable for its collocated version and does not need a numerical model of the system to be controlled. Robustness of the system is asymptotically guaranteed. The proposed isolation device, made of alumina for passive structure and made of PZT and PVDF for transducing layers, is experimentally tested. Experimental performances are compared with theoretical performances.

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1. Introduction

Vibration isolation is necessary in two broad classes of problems:

• A vibrating element is fixed on a structure. Mechanical waves propagate through this whole structure. Thus, they can damage the different sensitive elements of the structure or reduce their service life.
• A sensitive element is fixed on a vibrating structure. So, vibrations can modify operating points of this element but also strongly damage it.

The passive solution is the simplest way to achieve vibration isolation. Several passive techniques are studied in the literature by using elastomer materials [1], by using shape memory alloys [2,3] or by modifying mechanical impedances [4].

The passive suspension, sketched in Fig. 1, is considered.

The transmissibility of the system, i.e. the relationship between the acceleration of the mass (\(W_s\)) and the acceleration imposed to the support (\(W_u\)) is written in Laplace’s variables:

\[
T_{W_s,W_u} = \frac{(W_s)}{(W_u)} = \frac{s \cdot C + K}{s^2 \cdot M + s \cdot C + R}
\]

* Corresponding author.
E-mail addresses: yann.meyer@gmail.com (Y. Meyer), manuel.collet@univ-fcomte.fr (M. Collet).

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